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PHYSICS.—*A note on the change of compressibility with pressure.*[1] LEASON H. ADAMS, Geophysical Laboratory, Carnegie Institution of Washington.

The compressibility of practically all substances decreases with increasing pressure. For most solids this decrease is a very small quantity because the compressibility itself is very small; indeed, the change in compressibility is so minute that it is only by the use of delicate experimental methods and of a large pressure-range (10,000 megabaryes[2] or more) that it can be measured. It is sometimes convenient to determine the mean compressibility over a given pressure-range and not convenient or practicable to measure the variation of compressibility with pressure. The object of this note is to call attention to the relation between compressibility and change of compressibility of crystalline substances of moderate or low compressibility, for the purpose of providing an estimate of the pressure-coefficient of compressibility when the compressibility only is known.

The results of available measurements are shown in Table 1. The second column gives the compressibilities of the substances listed in the first column, and in column 3 are the corresponding values of the change of compressibility with pressure.

The compressibility β, according to the usual custom, is defined as the relative change in the volume V per unit increase in pressure, P. That is,

$$\beta = -\frac{1}{V_0}\frac{dV}{dP}$$

in which V_0 is the volume at $P = 0$; and β_0 is the compressibility at

[1] Received November 19, 1927.

[2] The megabarye (sometimes called the megabar) is the equivalent of 10^6 dynes per sq. cm. One megabarye = 0.987 atm.

zero pressure. In Table 1 the quantity, $-\Delta\beta$, means $-10^{10}\frac{d\beta}{dP}$, and is the decrease in the value of $10^6\beta$ for 10,000 megabaryes increase o pressure. For these substances of moderate compressibility $\frac{d\beta}{dP}$ is independent of pressure—at least within the error of experiment.

Two widely different methods have been used in obtaining compressibilities of solids. The one involves the measurement of the change of *length* of a specimen when subjected to pressure. This method is capable of great precision and is the one by which the larger part of the data in Table 1 was obtained. It has the disadvantage that the cubic compressibility can be obtained from a single series of measurements only when the substance belongs to the cubic system and is not aeolotropic from deformation or lack of homogeneity. The other method determines the volume-change and hence the cubic compressibility directly, and gives a true result for aeolotropic materials. Its disadvantage is its lesser sensitivity as compared with the linear method.

All of the available data for crystalline solids whose compressibility is $8\cdot10^{-6}$ or less are plotted on Figure 1, except tellurium, which does not fall in the diagram, and the alkali halides[9] which are known to be abnormal in many respects as compared with other compounds. The points for the alkali halides lie somewhat above the other points, forming, in a general way, a separate family of points. In the plot, measurements on cubic metals by the linear method are denoted by circles; direct measurements of cubic compressibility, or linear measurements in three directions on metals, by triangles; and measurements of all kinds on compounds, by crosses. Data for which different results were obtained with different samples (e.g. aluminum) are averaged to give a single point. Linear measurements with substances not belonging to the cubic system, on samples cut in one direction only, have not been included. It will be noted that in general $-\Delta\beta$ increases with β, that is, the greater the compressibility, the more it changes with increasing pressure. At first sight the points do not seem to fall any too well on a single curve, and yet the five or six points that are considerably off the curve probably attract the attention unduly as compared with the thirty or more points that do lie on or near the curve.

It is not the purpose of the writer to urge that $\Delta\beta$ is a single-valued function of β for all solids. In all probability $\Delta\beta$ depends on other

[9] Slater, Phys. Rev. **23**: 488. 1924.

TABLE 1.—COMPRESSIBILITY AND CHANGE OF COMPRESSIBILITY WITH PRESSURE FOR VARIOUS SOLIDS. THE UNIT OF PRESSURE IS THE MEGABARYE

MATERIAL	COMPRESSIBILITY 10β	CHANGE OF COMPRESSIBILITY $-\Delta\beta$	REFERENCE
Iron	0.60	0.04	8
Platinum (wire)	0.37	0.04	8
Platinum (rod)	0.31	0.00	8
Molybdenum	0.36	0.02	8
Tantalum	0.49	0.01	8
Tungsten	0.32	0.03	4,8
Palladium	0.53	0.04	8
Nickel	0.54	0.04	8
Cobalt	0.55	0.04	8
Gold	0.59	0.05	8
Copper	0.74	0.06	8
Uranium	0.99	0.05	8
Silver	1.01	0.09	8
Aluminum (rod)	1.39	0.07	8
Aluminum (casting)	1.37	0.10	8
Germanium	1.41	0.14	8
Lead	2.39	0.31	3,8
Cerium	3.65	0.40	8
Calcium	5.84	1.00	8
Strontium	8.35	1.51	8
Zinc	1.73	0.27	3,8
Bismuth	2.99	0.47	3,4
Antimony	2.75	0.65	4
Tin	1.90	0.28	3,4
Rhodium	0.38	0.56	5
Iridium	0.27	0.03	5
Cadmium	2.24	0.59	3
Quartz	2.70	0.44	3,7
Mica	2.34	0.40	6
Oligoclase	1.74	0.21	6
Microcline	1.92	0.29	6
Magnetite	0.55	0.04	7
Pyrite	0.70	0.04	7
Fluorite	1.23	0.13	7
Calcite	1.36	0.08	7
Celestite	1.59	0.16	7
Galena	1.91	0.13	7
Sphalerite	1.30	0.04	7

[3] Adams, Williamson, and Johnston, Journ. Am. Chem. Soc. **41**: 12. 1919.
[4] Bridgman, Proc. Am. Acad. Arts Sci. **60**: 305. 1925.
[5] Bridgman, Proc. Am. Acad. Arts Sci. **59**: 109. 1924.
[6] Adams and Williamson, Journ. Frank. Inst. **195**: 475. 1923.
[7] Bridgman, Am. Journ. Sci. **10**: 483. 1925.
[8] Bridgman, Proc. Am. Acad. Arts Sci. **58**: 165. 1923.

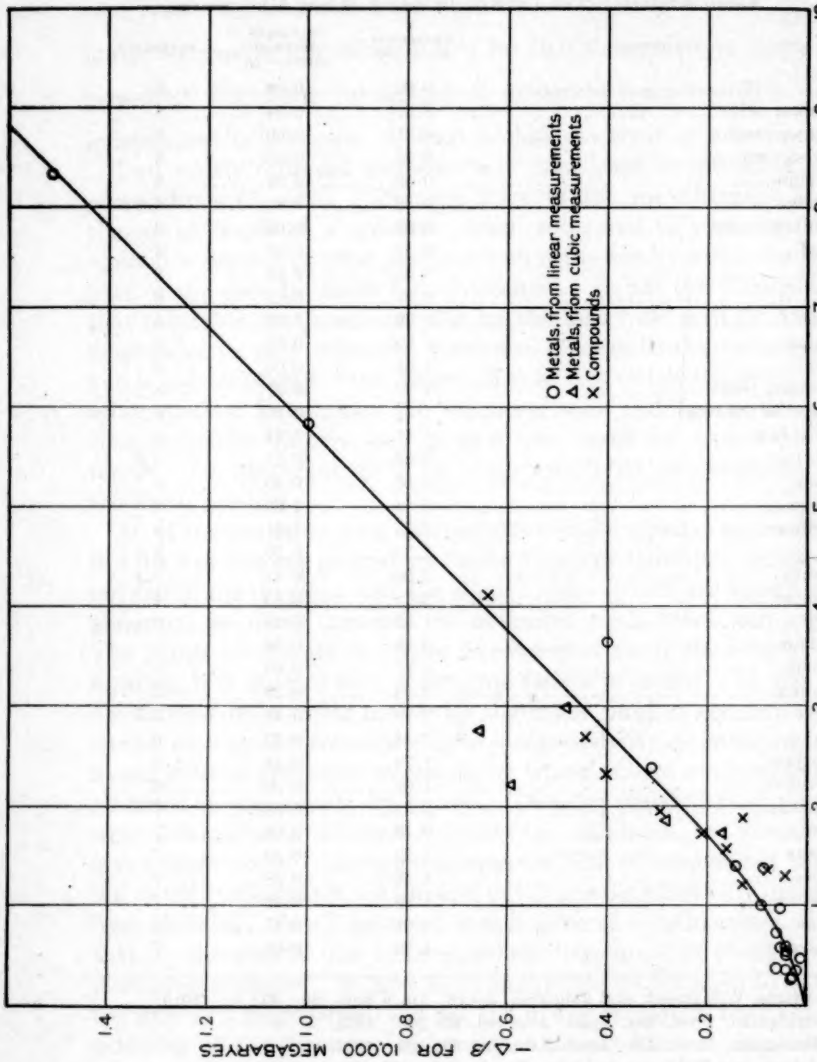

Figure 1.—The compressibility, $10^6\beta$, is plotted against $-\Delta\beta$, which is the decrease in $10^6\beta$ caused by 10,000 megabaryes increase of pressure. The deviation of most of the points from the curve is hardly greater than the experimental error.

factors, but the divergence of the points in Figure 1, is for the majority of the materials, hardly larger than the error of experiment—experimental error caused perhaps more by a lack of compactness in the material than by the direct errors of observation. This effect in crystalline aggregates is well illustrated by the behavior of marble. Ordinary marble may show, under pressure, a perfect volume-elasticity, yet at low pressures the compressibility is abnormally high and falls more rapidly than can be accounted for by the elastic properties of the calcite grains themselves.

It is believed that the curve in Figure 1 will be of practical value in providing a rough estimate of the change of compressibility in substances for which the mean compressibility only, over a given pressure range, is known. For example, if the mean cubic compressibility of a material over the pressure range from 0 to 10,000 megabaryes were found to be 1.10×10^{-6}, then from the value of $\Delta\beta$ given by the curve it would follow that $10^6\beta$ would be 1.16 at zero pressure and 1.04 at $P = 10{,}000$. It is probable that these estimated values would not be in error by as much as $\pm$ 0.02.

A solution of the problem of the change of compressibility with pressure must await a more complete knowledge of the dynamics of the atomic aggregates in crystals. The problem must be attacked from the theoretical side as well as the experimental, and until more is known of interatomic forces as a function of distance, any prediction as to $\Delta\beta$ for a substance, if the mean compressibility only is known, must be made by some empirical method. For solids of moderate compressibility (excluding the alkali metals and alkali halides) the curve given in the figure will provide an estimate of the change of compressibility accurate enough for many purposes.

SUMMARY

The change of compressibility with pressure for crystalline solids is to a rough approximation dependent on the compressibility itself, the two quantities increasing together. The mutual relation is more obvious if the halides of the heavier alkalis be excluded; 85 per cent of the remaining observations deviate from a single smooth curve by an amount which is hardly greater than the experimental error. Hence this curve may be used to determine the order of magnitude, at least, of the pressure-coefficient of compressibility, if the mean compressibility over a given pressure-range is known.

MINERALOGY.—*Almandite-spessartite garnet from Gwynns Falls, Baltimore.*[1] EARL V. SHANNON and FOREST A. GONYER.

Pegmatite in the gneiss which is quarried at Gwynns Falls, Baltimore, bears garnet as scattered and fairly large crystals in a fairly coarse pegmatite, and as small crystals distributed in parallel lines in finer-grained pegmatite. The garnet of the latter rock, which presents a marked similarity to the banded garnetiferous rock in some of the gem-bearing pegmatites of the Southern California tourmaline field, was analyzed in the laboratory of the National Museum and the results are presented herewith.

The specimen from which the analyzed material came consists principally of quartz and feldspar in granular gneissic bands with some schistose mica partings. The feldspar is principally white to pale buff orthoclase and forms grains up to 1 centimeter across. The garnet is aggregated into granular, parallel and somewhat wavy bands from 1 to 3 millimeters wide which follow the general parallel structure of the rock. These bands consist of imperfectly euhedral crystals averaging 0.5 millimeter but reaching an extreme size of 2.0 millimeters and isolated in quartz and feldspar. The color ranges, according to size, from pale brownish pink to dark brownish red.

Garnet-rich pieces were crushed and screened between 40 and 100 mesh sieves, and the minerals separated with methylene iodide heavy solution. The cleaned sample consisted principally of euhedral garnet crystals formed by an equal development of the faces of the trapezohedron and the rhombic dedocahedron. The final sample showed only a very small number of extraneous grains, principally of adhering quartz, and when ground for analysis was homogeneously isotropic. The analysis gave the following results:

ANALYSIS AND RATIOS OF GARNET FROM BALTIMORE

(Forest A. Gonyer, analyst)

Constituent	*Per cent*	*Ratios*			
SiO_2	35.82	.594	.594	.198 × 3	.98 × 3
Al_2O_3	21.39	.209	.218	.218 × 1	1.08 × 1
Fe_2O_3	1.44	.009			
FeO	21.58	.300	.596	.199 × 3	.99 × 3
MgO	.48	.012			
MnO	17.15	.242			
CaO	2.34	.042			
	100.20				

[1] Published by permission of the Acting Secretary of the Smithsonian Institution.

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It will be seen from the analysis that the garnet is a member of the almandite-spessartite series and contains the ferrous iron molecule a little in excess of the manganese molecule. Most all garnets from granitic pegmatites belong to this series. When the bases are combined in constituent molecules, the following mineralogical composition is derived from the analysis:

Molecule	*Formula*	*Ratio*	*Per cent*
Almandite	$3FeO \cdot Al_2O_3 \cdot 3SiO_2$	.100	49.87
Spessartite	$3MnO \cdot Al_2O_3 \cdot 3SiO_2$	.081	40.17
Andradite	$3CaO \cdot Fe_2O_3 \cdot 3SiO_2$	.009	4.58
Grossularite	$3CaO \cdot Al_2O_3 \cdot 3SiO_2$	.005	2.26
Pyrope	$3MgO \cdot Al_2O_3 \cdot 3SiO_2$	.004	1.62
Alumina (excess)	Al_2O_3	.019	1.82
			100.32

The calculated index of refraction of a garnet of the above composition, excluding the excess alumina and using Ford's data for the end members, is 1.816 while the index of refraction of the analyzed powder was found to be 1.808.

The ratios of the first table show that the silica almost exactly balances the bivalent bases whereas the trivalent bases are a little too high to conform exactly with the garnet formula and show an excess of 1.82 per cent of alumina in the second table. Many analyses of manganese-bearing garnets present a deficiency of trivalent bases, and to conform to the general garnet formula $3R''O \cdot R'''_2O_3 \cdot 3SiO_2$ it is necessary to assume some of the manganese to be present in the trivalent state. As shown in a previous communication,[2] the deficiency may at times be due to analytical error. In the present analysis the basic acetate method for separation of manganese from iron and alumina was not used, the iron and alumina being precipitated only by ammonia. The results showed trivalent bases high instead of low, as is usual when the acetate method is employed. The whole analysis was then repeated and the results checked with the greatest care. As manganese is the most troublesome element in such an analysis, the additional amount of manganese in the weighed iron and alumina was determined. The precipitate obtained from the final ammonia precipitation was ignited, weighed, fused with potassium bisulphate, and obtained in sulphate solution in the usual manner. The solution was then made up to a volume of 250 cubic centimeters

[2] EARL V. SHANNON, *"Blythite" and the manganese garnet from Amelia, Virginia.* Journ. Wash. Acad. Sci. **17**: 444–453. 1927.

in a calibrated flask. One fifth (50 cubic centimeters) of the solution was withdrawn with a pipette and the manganese in it determined colorimetrically. The balance of the solution was reduced, titrated for iron, and tested for titanium as usual. Minor amounts of manganese contaminating the lime and magnesia precipitates were likewise colorimetrically estimated and appropriate corrections made. The results were highly satisfactory and it has been concluded to avoid the use of the basic acetate method in future analyses.

MINERALOGY.—*Natrojarosite from Kingman, Arizona.*[1] EARL V. SHANNON and FOREST A. GONYER.

Since the discovery that jarosite or members of the jarosite group of minerals are unusually common in the oxidized portions of ore deposits, especially in desert regions or areas of more or less arid climate, the interest in this group has increased among geologists and practical mining men as well as among mineralogists. Following the description of the original potash jarosite there were found, almost simultaneously, other analogues of the compound in which soda and lead were essential bases. The lead compound, plumbojarosite, has in numerous places been worked as an ore of lead, and a variety occurring in small amount at the Boss mine, Nevada, proved to contain relatively very large amounts of platinum and palladium. In addition to these most interesting minerals, analogues of jarosite in which the potash is replaced by silver oxide and ammonium oxide have recently been found in Utah. In appearance these jarosites are so similar that they cannot be distinguished from each other without chemical tests. Although distinct and measurable crystals have been found, the minerals usually vary from yellow to brown in color, are more or less earthy in texture, and have in many cases been mistaken for earthy limonite. The finer-grained examples are dull in luster, but the coarser varieties are usually silky or satiny in lustre.

A large lot of specimens of a jarosite was received at the National Museum from Mr. W. F. Smith, of Kingman, Arizona. The locality is given as the Georgia Sunset mining claim, ¾ mile east of McConnico, a station on the Santa Fe Railroad in Mohave County, 4 miles south of Kingman. Since the material was pure and in good specimens

[1] Published by permission of the Acting Secretary of the Smithsonian Institution. Received November 17, 1927.

which it was desirable to preserve in the collections, it was analyzed. A representative specimen of the purer material was ground, and when examined under the microscope was found of satisfactory quality. The analysis gave the following results:

ANALYSIS AND RATIOS OF NATROJAROSITE

Constituent	Per cent	Ratio		
Insoluble	.22			
Fe_2O_3	48.23	.302	.303	1.01 × 3
Al_2O_3	.09	.001		
FeO	.58	.008	.103	1.03 × 1
CaO	.05	.001		
MgO	.05	.001		
Na_2O	4.28	.069		
K_2O	2.28	.024		
Ag_2O	none			
PbO	trace			
$(NH_4)_2O$	none			
SO_3	33.71	.421	.421	1.05 × 4
H_2O	10.76	.597	.597	.99 × 6
	100.25			

The ratios give the formula for natrojarosite, $(Na,K)_2O \cdot 3Fe_2O_3 \cdot 4SO_3 \cdot 6H_2O$. The material is free from more than traces of silver and lead although a larger sample might have shown precious metals upon assay.

The material is compact to earthy and golden-brown to yellow. The more friable and lustreless portions greatly resemble common yellow ocher. Other specimens consist of a greatly altered, kaolinized or sericitized, and bleached igneous rock heavily impregnated with pyrite. Others are similarly altered rock from which the pyrite has decomposed, leaving jarosite obviously derived by oxidation from the pyrite.

Under the microscope the mineral is clean, transparent, greenish-yellow, and nonpleochroic with high birefringence. The powder is made up of tabular crystal grains, many of which show hexagonal or rhombohedral boundaries. Many of the crystals lie on their basal plane and since these are dark in all positions between crossed nicols the mineral is uniaxial, or nearly so, and is negative. The indices of refraction measured are: $\omega = 1.829$, $\epsilon = 1.760 \pm 0.002$. The differences in optical properties between the several members of the group are not such that they can be differentiated microscopically.

PETROLOGY.—*Rocks of the Galápagos Islands.*[1] H. S. WASHINGTON and MARY G. KEYES, Geophysical Laboratory, Carnegie Institution of Washington.

In 1923 the Harrison Williams expedition of the New York Zoological Society visited the Galápagos Islands, where extensive zoological collections were made.[2] Dr. Beebe, Director of Scientific Work, was so good as to collect some of the rocks, in spite of the very limited time at the disposal of the expedition. For this and for his kind permission to describe some of the specimens we would express our hearty thanks.

This small group of wholly volcanic islands, lying on the equator about 500 miles west of Ecuador, was first made known to science by Charles Darwin, who visited them in 1835 during the famous cruise of the *Beagle* and described them in a classic chapter.[3] Since then several other expeditions have visited the group, as noted by Beebe in his book cited above. Most of these expeditions were for zoological and botanical purposes and, apart from Darwin's masterly observations, the literature on the petrography of the islands is very scanty. Of the papers that deal especially with the rocks of the islands there appear to be but two that need to be mentioned here and that are not included in Beebe's bibliography. One is a paper by Gooch[4] describing a set of specimens given him as a student by Tschermak; the other is a brief report by Merrill[5] on a small collection of rocks made during the *Albatross* expedition in 1891. Neither Zirkel nor Rosenbusch do more than make very brief mention of the "palagonite" tuff.

Darwin estimated the number of craters at about 2,000, and several of them have been in eruption during the last hundred years or so.[6] The lavas, in general, have been considered to be basaltic, with the peculiar yellow tuff described by Darwin, but the papers by Gooch and by Merrill give indication that there may be considerable variety, as will be noted later. The specimens especially studied by us were collected by Beebe on Eden, an islet off the northwest coast

[1] Received November 19, 1927.

[2] WILLIAM BEEBE, *Galapagos: World's End.* New York, 1924.

[3] DARWIN, *Geological Observations*, 3rd. ed., London, pp. 110–131, 1891.

[4] FRANK A. GOOCH, Tsch. Min. Mitth. **6**: 133. 1876.

[5] MERRILL, Bull. Mus. Comp. Zool. **16**: 235. 1893.

[6] See SAPPER, *Katalog der geschichtlichen Vulkanausbrüche*, p. 95, 1917. Also BEEBE, op. cit., pp. 411, 412, (ca. 1912, 1897). These two eruptions are not mentioned by Sapper.

of Indefatigable. They consist of basalt and of the peculiar yellow tuff; the other specimens were so altered as scarcely to repay study.

Basalt.—The rock is dense, non-scoriaceous, and very fine-grained, but not aphanitic, small glistening crystals of feldspar being visible through the mass. The color is very dark brownish gray—almost black. A few very small phenocrysts of feldspar are seen here and

TABLE 1.—BASALTS OF GALÁPAGOS AND OF HAWAII

	(1)	(2)	(3)
SiO_2	48.24	48.04	48.42
Al_2O_3	15.82	15.35	13.97
Fe_2O_3	0.78	5.72	4.17
FeO	9.84	7.67	9.57
MgO	5.84	5.77	4.61
CaO	9.84	10.13	8.86
Na_2O	3.63	3.26	3.30
K_2O	0.64	0.79	1.29
H_2O+	0.72	0.27	0.84
H_2O-	0.11	0.04	0.42
TiO_2	3.88	3.13	3.25
P_2O_5	0.16	0.33	0.91
MnO	0.20	0.10	0.17
	99.70	100.62	99.78
NORMS			
Q	——	——	0.84
Or	3.89	4.45	7.78
Ab	29.87	27.77	27.77
An	25.02	24.74	19.46
Ne	0.28	——	——
Di	18.67	18.65	15.49
Hy	——	8.91	12.88
Ol	11.98	0.76	——
Mt	1.16	8.35	6.03
Il	7.45	5.93	6.23
Ap	0.34	0.67	2.02

(1) Andesine basalt, Eden Islet, Galápagos Islands. Keyes analyst.
(2) Andesine basalt, Hualalai, Hawaii. Washington analyst. Am. Journ. Sci. **6**: 104. 1923.
(3) Andesine basalt, Mauna Kea, Hawaii. Washington analyst. Am. Journ. Sci. **5**: 493. 1923.

there. In thin section, the texture is seen to be ophitic, the rock being made up of tables of andesine (about Ab_3An_2), with interstitial, anhedral, pale brown, non-pleochroic augite, and very few rather larger rounded olivines. There is no magnetite, but considerable darkish brown glass in interstitial patches. A narrow rim of the glass surrounds the olivines.

The chemical composition of this basalt is shown in No. 1 of Table 1. The analysis is that of a normal basalt, which may be matched by several of the basalts of Hawaii, as shown in Nos. 2 and 3 of Table 1. The only features worthy of special mention are the great preponderance of FeO over Fe_2O_3, and the high Na_2O and TiO_2.

Tuff.—Darwin devotes considerable space to the description and discussion of the origin of "a singular kind of tuff," which forms craters on Chatham and James Islands. This is the so-called "palagonitic" tuff of Bunsen, Zirkel, and Rosenbusch. All the specimens examined by us came from the small islet of Eden.

This tuff is very dense and compact, but most specimens can be readily scratched with a knife, having a hardness of 3 to 4. The color is a rather light, yellowish brown and the luster is peculiar—greasy or, as Darwin puts it, resinous. Fragments are slightly translucent on thin edges. The mass contains very small (1 to 2 mm.) grains of black augite and also fragments of basaltic lava, some of them scoriaceous.

The making of coherent thin sections of this tuff, using the most compact specimen, proved a matter of much difficulty, as the section broke up and spread into a number of detached pieces. The greater part of the material is composed of small angular fragments of clear bright yellow glass, slightly mottled, the average index of refraction being 1.585, as kindly determined by Dr. Merwin. This glass contains a few small inclusions, some of them of augite and some indeterminable, with a few small ellipsoidal vacuoles. These glass fragments are separated by a white doubly refracting mineral of very low refractive index, which appears to be zeolitic. The presence of this accounts for the peculiar action of the section. A few grains of olivine and one or two of augite are seen.

An analysis of a compact specimen, free from basalt fragments and from veinlets of calcite, is given in No. 1 of Table 2, with one of a similar tuff made by Bunsen in 1851, and several analyses of similar rocks. In No. 1 the low SiO_2, MgO, and K_2O are noteworthy, and it is very evident that the iron is almost wholly in the ferric state. The amount of H_2O (both + and −) is remarkably high, the two together making up almost 21 per cent of the rock. Unquestionably much of this belongs to the rather abundant zeolitic material, but some of it is also probably contained in the glass. The complete absence of CO_2 in such a hydrated tuff is noteworthy. The analysis by Bunsen, one of three made some 75 years ago, is of only historic

interest, but in its general outlines it greatly resembles the recent one and is evidence of Bunsen's accurate work, given the facilities and methods of the time.

As compared with analyses of similar rocks composed mainly of yellow glass, some analyses of which are given in the table, the Eden tuff is much less alkalic than the yellow tuff of San Felix (No. 3), which is derived from a nephelite basanite, and differs in other respects, especially in Al_2O_3 and MgO. If it is assumed that there

TABLE 2.—ANALYSES OF PALAGONITIC TUFFS

	(1)	(2)	(3)	(4)	(5)	(6)
SiO_2	38.13	38.07	36.35	48.90	47.75	46.58
Al_2O_3	14.64	13.03	8.14	13.80	18.34	18.61
Fe_2O_3	7.93	9.99	5.57	5.77	9.94	7.43
FeO	0.87	——	3.50	6.84	1.09	3.73
MgO	3.84	6.58	9.05	8.85	4.78	7.93
CaO	8.97	7.54	7.44	7.27	11.25	8.14
Na_2O	2.67	0.70	4.70	5.32	3.34	3.85
K_2O	0.15	0.94	3.25	0.96	0.19	0.72
H_2O+	12.34	23.14	4.01	1.65	——	——
H_2O-	8.41		8.35	——	——	——
CO_2	none	n.d.	4.00	trace	——	——
TiO_2	2.50	n.d.	4.76	0.71	3.12	3.01
P_2O_5	0.01	n.d.	0.83	0.04	0.01	——
MnO	0.15	n.d.	n.d.	trace	0.19	——
	100.61	100.00	99.95	100.11	100.00	100.00

(1) Palagonitic tuff, Eden Islet, Galápagos Islands. Keyes analyst.
(2) Palagonite, Galápagos Islands. Bunsen analyst. Ann. Chem. Pharm. **83**: 221. 1851. (Calculated to 100).
(3) Basanite tuff, Cerro Amarillo, San Felix Island. Washington analyst. Bull. Geol. Soc. Amer. **35**: 381. 1924.
(4) Palagonite ("Basalt glass"), Palagonia, Sicily. Ponte analyst. Atti Accad. Gioenia (5) **3** (10): 7. 1910.
(5) Analysis No. 1 calculated to 100.00, as free from H_2O.
(6) Yellow basalt tuff, Monte Pozzolana, Linosa Island. Calculated to 100.00, as free from H_2O and CO_2. Washington analyst. Journ. Geol. **16**: 29. 1908.

has been no loss or other considerable change in the bases and if the analysis (No. 1) is calculated to 100 per cent on an H_2O-free and CO_2-free basis (No. 5), the result differs along much the same lines from the analysis of a palagonite of Sicily (No. 4), this being an altered basaltic glass occurring in basaltic tuffs, but peculiar because of its highly sodic character and low water content. On the whole, the Galápagos tuff, calculated to 100 per cent, most resembles the tuffs of the island of Linosa, which are derived from feldspathic basalts.

So, although the evidence may not be conclusive because of the small number of specimens, yet it may be assumed that this peculiar yellow Galápagos tuff, or rather the predominant glass, is derived from basaltic rather than from tephritic lavas. At the same time, these yellow basaltic or tephritic glasses are so peculiar that the term "palagonitic" may well be applied to them.

The origin of these Galápagos tuffs was a source of much speculation to Darwin, who finally concluded that they were "produced by the grinding together of fragments of lava within active craters, communicating with the sea." The modern methods of study of rocks in thin section, unknown in his day, do not bear this out, but indicate, rather, that these and similar palagonitic rocks are much altered basaltic (or tephritic) glasses. The subject will be taken up again when specimens collected in the Val di Noto, Sicily, are studied.

Conclusions.—In so far as the material at our command permits us to judge, it would appear that the lavas of the Galápagos Islands are chiefly andesine (and probably also labradorite) basalts, with their peculiar tuffs, which latter, as stated by Darwin "present the most striking feature in the geology of this Archipelago." At the same time the few brief notes given us by Gooch and Merrill indicate some features of greater complication and of especial interest as bearing on the relations of this group of volcanic islands to others of the Pacific. Both of these authors describe most of their specimens as being ordinary feldspar basalts, and Gooch explicitly states that nephelite was not observed in any of the specimens examined by him. Gooch, however, very briefly notes some pumice[7] containing orthoclase, from Indefatigable and Abingdon.[8] Determinations by Gooch on the Indefatigable pumice showed 61.48 per cent of SiO_2 and 12.45 per cent of loss on ignition. The rock is, therefore, obviously trachytic or rhyolitic. Merrill also briefly describes an "andesite (?)" from Cocos Island, of which a "rough analysis" yielded the following results: SiO_2, 56.50; Al_2O_3, Fe_2O_3, 28.20; CaO, 2.83; MgO, 0.98; K_2O, 4.25; Na_2O, (by difference) 6.68; Sum, 99.44. The rock contained Cl "derived presumably from ocean spray." He remarks that "this indicates that the rock is more nearly related to the andesites than trachytes, though abnormally rich in potash." In other words, the rock appears to be trachyandesitic.

[7] GOOCH, op. cit., p. 137.

[8] Darwin states that he could find no pumice or trachyte on any of the islands.

These two observations, scanty as they are, show clearly that not only are the lavas of the Galápagos more complicated and varied than has been generally thought, but—and this is a matter of especial importance—that there is much similarity between their lavas and those of most of the Intro-Pacific volcanic islands. Thus, we find such "trachyandesites" at Hawaii and at other islands, and moreover trachytic lavas occur with basalts at many of them;[9] as on Hawaii, Maui, Molokai, in the Hawaiian Islands; Tutuila in the Samoan group; Tahiti; Juan Fernandez Islands; San Felix; Nukuhiva, Marquesas; and several others. A "phosphatized trachyte" is known from Clipperton Atoll, many hundred miles north of the Galápagos.[10]

This very general occurrence of trachytic and trachyandesitic lavas with dominant basalts is a feature of the petrology of the Pacific of very great importance, and one that appears to be of great bearing on some problems of geophysics. But it cannot be discussed here. It need only be said that thorough study of the lavas of the Galápagos Islands is highly desirable.

PALEONTOLOGY.—Pycinodesma, *new name for* Pycnodesma *Kirk not Schrammen.*[1] EDWIN KIRK, U. S. Geological Survey.

Under the title "*Pycnodesma*, a new molluscan genus from the Silurian of Alaska," (Proc. U. S. Nat. Mus. **71**; Art. 20, No. 2692. 1927) I proposed the generic name *Pycnodesma*. This name had been used by Schrammen for a Cretaceous sponge, and I therefore propose the name *Pycinodesma*, with *Pycinodesma giganteum* Kirk as the genotype, for this group of Silurian pelecypods.

[9] The references need not be given here. Some of the observational and analytical data are as yet unpublished.

[10] TEALL, Quart. Journ. Geol. Soc. **44**: 230. 1898.

[1] Published by permission of the Director, U. S. Geological Survey. Received November 17, 1927.

ENTOMOLOGY.—*New species of American Lepidoptera of the families Limacodidae and Dalceridae.*[1] HARRISON G. DYAR, U. S. National Museum. (Communicated by AUGUST BUSCK.)

The species here mentioned will be discussed more fully in other places, but it is desirable to validate the names as soon as possible.

Family LIMACODIDAE

Genus APODA Haworth

Apoda maxima, new species

Fore wing ocher-brown to reddish brown, the terminal area slightly paler than the basal one, or not so; a dark, somewhat oblique line across the middle, edged with whitish without. Hind wing a shade lighter than fore wing. Expanse, male, 27 mm., female, 28 mm.

Male and female, Type No. 40665, U. S. Nat. Mus., Big Bend, Brewster County, Texas, 5000–7000 feet alt. (O. C. Poling, gift of F. Johnson).

Genus SIBINE Herrich-Schäffer

Section 1. *Anellus of male hypopygium with a dorsal chitinous tongue*

Sibine clarans, new species

Fore wing narrow, elongate, rather pointed; dark rufous brown, the veins, especially median and at base, blackish shaded; three white subapical dots, one small subbasal dot. Hind wing rosy whitish, inner area rosy brown. Expanse, male, 38 mm. Anellus with a horn on each side.

Two males, Type No. 40666, U. S. Nat. Mus., No. 860, Cornell University Coll., Yahuarmayo, Peru, 1200 feet, alt., April, 1912 (Dognin Collection); El Campaniente, Col. Perene, Peru, June 14, 1920 (Cornell Univ. Exp.).

Sibine dorans, new species

Like *clarans;* a little less rufous. Male anellus without horns; spines of penis a wide mass of small ones.

Five males, Type No. 40667, U. S. Nat. Mus., La Oroya, Rio Inambari, Carabaya, Peru (Dognin Collection).

Sibine tontineans, new species

Similar to *clarans* and *dorans,* anellus without horns, spines of penis in a line, small at base, very large in the middle, small again at tip. Expanse, male 33–35 mm.

Two males, Type No. 40668, U. S. Nat. Mus., St. Jean du Maroni and Nouveau Chantier, French Guiana (Le Moult, Dognin Collection).

Sibine giseldans, new species

Like *tontineans,* but much smaller in size. Expanse, male, 29 mm. Spines of penis a mass of very long slender ones.

One male, Type No. 859, Cornell Univ. Coll., below Rio Negro, Amazonas, Brazil, September, 1920 (Cornell Univ. Exp.).

[1] Received November 12, 1927.

Sibine joyceans, new species

Fore wing trigonate, rather short, dark, less reddish than in *horrida;* dots white, the subapical ones consolidated in an oblique line; hind wings rather dark. Expanse, male, 30–33 mm., female, 40–43 mm. Spines of penis numerous terminally, small, the basal ones few and large.

Five males, two females, Type No. 40669, U. S. Nat. Mus., Panama (Busck and Zetek).

Sibine iolans, new species

Dark rufous brown as in *pallescens* Dogn. (= *rufescens* Walk.). Male without dots or markings. Hind wing pale rosy brown. Expanse, male 31–35 mm. Male hypopygium as in *nitens,* the spines of penis more slender and numerous.

Three males, Type No. 40670, U. S. Nat. Mus., Paramaribo, Surinam, May, 1904 (W. Schaus); Cayenne, French Guiana, June, 1904 (W. Schaus); French Guiana, 1900 (Pouillon).

Sibine norans, new species

Dark rufous brown without dots; hind wing dark brown. Male hypopygium as in *pallescens* (= *rufescens*), but the harpe finger-shaped at tip, oblique on one side. Expanse, male, 30–40 mm., female, 43–45 mm.

Eleven males, three females, Type No. 40671, U. S. Nat. Mus., São Paulo, Castro and Santa Catherina, Brazil; Paraguay (Schaus and Dognin Collections).

Sibine didactica, new species

Smaller than *norans,* similarly marked; two subapical and one subbasal white dots. Male aedoeagus a very narrow tube, much narrower than in *nitens,* etc.

One male, Type No. 40672, U. S. Nat. Mus., from the British Guiana Museum, presumably collected in that country.

Sibine ximenans, new species

Dark purple brown like *nitens,* the dots minute; hind wing very dark. Male hypopygium as in *joyceans,* the spines of penis numerous throughout, long and about alike. Expanse, male, 32 mm.

One male, Type No. 40673, U. S. Nat. Mus., Rio Tocantins, Brazil (Dognin Collection). Another male in the Cornell University Collection is not made an allotype because the number of spines of the penis is much less. La Merced, Rio Chamchamayo, Peru, June 3, 1920 (Cornell Univ. Exp.).

Sibine violans, new species

Rather large, dark shining purple brown; dots pale yellow, large, and tending to confluence. Hind wing dark red-brown, the scales purplish and raised between the veins. Expanse, male, 33–35 mm., female, 48 mm. Generally similar to *bonaerensis* Berg, larger and more brilliantly marked.

Two males, one female, Type No. 40674, U. S. Nat. Mus., Muzo, Medina, and Pacho, Colombia (A. H. Fassl, Dognin Collection).

Sibine helenans, new species

A small species, smooth dark purple brown. Expanse, male, 25–28 mm., female, 40–42 mm. Male hypopygium as in *bonaerensis* Berg, but the wing-shape different, the present species having pointed fore wings.

Three males, Type No. 40675, U. S. Nat. Mus., Rurrenebaque, Bolivia, October, 1922 (W. M. Mann, Mulford Biological Exp.); Teffé, Amazonas, Brazil, September (A. H. Fassl, Dognin Collection). Also 14 males and three females examined from the Cornell University Collection from various localities on the Amazon and from Corumba, Matto Grosso, Brazil.

Sibine priscillans, new species

Large, rather light rufous brown, with red stain subapically and subbasally; single subapical and subbasal yellowish dots. Hind wing pale creamy. Expanse, male, 43 mm. Male hypopygium of the type of *violans*, *ximenans*, etc.

One male, Type No. 40676, U. S. Nat. Mus., Zacualpan, Mexico, November, 1914 (R. Muller, Dognin Collection).

Sibine laurans, new species

Blunt-winged, rather light purple brown, the fringe dark; a large orange-red shade along inner margin below a darker ray; no subapical marking, no dots. Expanse, male, 28 mm.

Two males, Type No. 40677, U. S. Nat. Mus., São Paulo Olivença, Amazonas, Brazil, November–December (A. H. Fassl, Dognin Collection).

Section 2. *Male anellus without dorsal chitinized tongue*

Sibine reletiva, new species

As in *extensa* Schaus; smaller, the spines of the male penis shorter but large and stout and followed by minute ones. Expanse, male, 30–35 mm., female, 40 mm.

Three males, one female, Type No. 40678, U. S. Nat. Mus., San Salvador, Central America (Dognin Collection).

Sibine ophelians, new species

As in *extensa*; blunter winged, somewhat less strongly marked and thinner scaled. Expanse, male, 30–35 mm., female, 46–50 mm. Hypopygium as in *reletiva*, the spines of penis fine, slender, not followed by minute ones.

Twelve males and three females, Type No. 40679, U. S. Nat. Mus., San Salvador, Salvador; Cayuga and Quirigua, Guatemala; Juan Vinas and Sixola River, Costa Rica (Schaus & Barnes); Lino, Panama; Pacho, Colombia (Dognin Collection).

Sibine gertrudans, new species

Blunt-winged, dark umber brown with little reddish tint; a blackish ray through cell and along submedian; dots obsolete. Hind wing purplish brown. Expanse, male, 30–35 mm. Hypopygium similar to *extensa*, the spines of the penis smaller. The wing-shape differs.

Eight males, Type No. 40680, U. S. Nat. Mus., Cuernavaca, Morelos, Mexico, July, August, November, December, 1906 (W. Schaus); Colima, Colima, Mexico, July, 1924 (R. Müller).

Sibine quellans, new species

Fore wing pointed, dark shining brown with contrasting areas; subbasal and subapical reddish stains, no dots. Hind wing rather dark brown. Expanse, male, 30 mm.

One male, Type No. 40681, U. S. Nat. Mus., San Antonio, Colombia, 5800 feet alt., December, 1907 (M. G. Palmer, Dognin Collection).

Sibine rollans, new species

Blunt- and square-winged; light rosy red-brown; a narrow blackish ray from base below cell, the inner area below it bronzy red. Hind wing rather brightly reddish brown. Expanse, male, 25–27 mm.

Eight males, Type No. 40682, U. S. Nat. Mus., St. Jean and St. Laurent, French Guiana (Le Moult); Yahuarmayo, Peru, April–May, 1912; Codajias, Coary and Teffé, Amazonas, all from the Dognin Collection. Also 9 males in the Cornell University Collection, not mounted, but agreeing superficially, Mackenzie, Demerara River, British Guiana, June 24, 1927; Tumatumari, Potaro River, British Guiana, June 27, 1927; Moengo, Cottica River, Surinam, May 23, 1927 (Cornell Univ. Exp.).

Sibine francesans, new species

Like *eucleides* Dyar, the wing even broader and squarer; a little less dark brown, the black ray under median vein more distinct. Expanse, male, 36 mm.

Two males, Type No. 40683, U. S. Nat. Mus., one without label, the other, Rio Songo, Bolivia (A. H. Fassl, Dognin Collection).

Sibine zellans, new species

Fore wing narrow, pointed, hind wing trigonate, the outer margin straight; dark purplish brown, no markings, the hind wing almost as dark as the fore. Expanse, male, 37 mm. Hypopygium with the two limbs of the aedoeagus irregular, one shorter than the other, the limbs quadrate, granular.

One male, Type No. 40684, U. S. Nat. Mus., Pará, Brazil (Moss).

Sibine berthans, new species

Like *zellans*, blacker, wings rather less pointed, the outer margin of hind wing convex. Female less intensely blackish, the ground brownish in places, a red apical stain, and subapical yellow streak on vein 6; hind wing lighter brown. Expanse, male, 34 mm., female, 54 mm. The spines of the penis are finer and more numerous than in *zellans*.

Male and female, Type No. 40685, U. S. Nat. Mus., Villa Rica, Paraguay, March, 1926 (F. Schade).

Sibine sarans, new species

Small, dark, blunt-winged, resembling *stimulea* Clem. Hypopygium as in *zellans*, but the limbs of aedoeagus slender, irregular. Expanse, male, 23 mm. Hypopygium much as in *pauper* Dyar.

One male, Type No. 40686, U. S. Nat. Mus., San Sebastian Retalhuleu, Guatemala (L. Thiel).

Genus EUCLEA Hubner

Euclea cassida, new species

Fore wing with light yellow ground, the scales suberect and thin; blotched with blackish, especially at base, and defining a pale pinkish patch between the subapical silver dots and subbasal strongly waved line; no discal dot visible. Expanse, male, 23–24 mm.

Two males, Type No. 40687, U. S. Nat. Mus., Amathura and Caicara, Amazonas, Brazil (Dognin Collection).

Genus TALIMA Walker

Talima sissypha, new species

As in *straminea* Schaus, but the whole wing darkened with purple-brown; inner and outer margins darker. Expanse, male, 21 mm.

One male, Type No. 40688, U. S. Nat. Mus., San Sebastian, Retalhuleu, Guatemala (L. Thiel).

Talima varians, new species

As in *flexilinea* Dyar the fore wing light purple brown, darker shaded at base; veins outwardly dark, crossing the slender flexuous outer line; apex broadly dark purple-brown beyond the line; hind wing rather pale stramineous, with a purple area across the middle. Expanse, female 23 mm.

One female, Type No. 40689, U. S. Nat. Mus., Venezuela (Dognin Collection).

Talima merilone, new species

Like *emilia;* larger, the fore wing heavily suffused, the veins not lined; a round clouded discal area. Expanse, male, 22–23 mm.

Two males, Type No. 40690, U. S. Nat. Mus., Colombia: Micay, August, 1896; Pueblo Rico, San Juan Choco, 5200 feet alt., September, 1909 (Dognin Collection).

Talima insulla, new species

Like *sulla* Schaus, but the outer dark line absent, replaced by a narrow pale yellow shaded line, which is rather faint in the male, distinct in the female. Expanse, male, 20 mm., female, 26 mm.

Two males, one female, Type No. 40691, U. S. Nat. Mus.; Type No. 857, Cornell Univ. Coll., below Codajos, Rio Solimões, Brazil, September 6, 1920 (Cornell Univ. Exp.).

Genus MONOLEUCA Grote & Robinson.

Monoleuca angustilinea, new species

Fore wing uniform red-brown; silvery line erect, sulphur-yellow tinted, narrow, slightly oblique, entering cell before origin of vein 2, preceded by faint reddish. Expanse, female, 23 mm.

One female, Type No. 40692, U. S. Nat. Mus., Capron, Florida, March 23 (H. G. Hubbard).

Genus SISYROSEA Grote

Sisyrosea brusha, new species

Fore wing dark purplish brown, sparsely sprinkled with black scales; hind wing distinctly blackish. Expanse, male, 20 mm.

Two males, Type No. 40693, U. S. Nat. Mus., Jalapa, Mexico (W. Schaus) Godeberi, Maroni River, French Guiana (Le Moult).

Genus NATADA Walker

Natada styx, new species

Like *deba;* darker brown, the lines obscure, divergent below; hind wing blackish. Expanse, male, 25 mm.

One male, Type No. 40694, U. S. Nat. Mus., Yahuarmayo, Peru, April, 1912 (Dognin Collection).

Natada ulaula, new species

Like *michorta;* larger, darker, the indicated transverse lines farther apart and less numerous. Expanse, male, 30 mm.

One male, Type No. 40695, U. S. Nat. Mus., Medina, Colombia, 500 m. alt. (A. H. Fassl).

Genus PEROLA Walker

Perola prosper, new species

Fore wing white, overlaid with olive brown, leaving a broad submarginal white band with rather irregular edges; white mottlings about cell and marginally; a dark dot in base of cell and large discal spot. Hind wing whitish. Expanse, male, 24–25 mm.

Three males, Type No. 40696, U. S. Nat. Mus.; Type No. 856, Cornell Univ. Coll., "Lassance," Minas Geraes, Brazil, November 9, 1919 (Cornell Univ. Exp.).

Perola subpunctella, new species

Like *subpunctata* Walk.; smaller. Expanse, male, 20–22 mm.

Seven males, Type No. 40697, U. S. Nat. Mus., Castro, Paraná, Brazil, (E. D. Jones); Villa Rica, Paraguay, February 9, 1921 (C. Jorgensen).

Genus ALARODIA Möschler

Alarodia minuscula, new species

White, without markings; fore wing below smoky shaded, darkest along costa. Expanse, male, 11 mm.

One male, Type No. 40698, U. S. Nat. Mus., Matanzas, Cuba, November, 1902 (W. Schaus).

Genus SEMYRA Walker

Semyra erna, new species

Markings of *eucharista,* but darkened, the silvery bar more distinct; hind wing blackish brown. Expanse, male, 17–19 mm.

Four males, Type No. 40699, U. S. Nat. Mus., Villa Rica, Paraguay (F. Schade).

Semyra lucilla, new species

Markings of *gladys,* the whole wing dark purple-brown, the spots distinct, although not contrasted. Hind wing brownish black. Expanse, male, 25 mm.

One male, Type No. 40700, U. S. Nat. Mus., Venezuela (Dognin Collection).

Genus ISOCHAETES Dyar

Isochaetes ashtabel, new species

Fore wing dark purple brown, hind wing bronzy black; some rufous patches basally; a black highly angled zig-zag line crossing the wing centrally, rufous-edged without, and below the median vein forming a deep excavation; a dark outer line excurved over cell inclosing a curved pale space at end of cell, which is ovate in its upper half, obscured except for two whitish patches below. Expanse, male, 18 mm., female, 26 mm.

Male and female, Type No. 40701, U. S. Nat. Mus.; Type No. 855, Cornell Univ. Coll., male, Molinas, Paraguay, October, 1925 (F. Schade), female, Rockstone, Essequibo River, British Guiana, June, 1927 (Cornell Univ. Exp.).

Genus VENADICODIA Dyar

Venadicodia ruthaea, new species

Fore wing brownish; basal space dark brown; a darker oblique bounding line from costa before middle to inner margin beyond middle; a little whitish in its irregular outer edge; outer area light brown; a small brown patch at apex, continued narrowly along termen. Hind wing blackish brown. Expanse, male, 18 mm.

One male, Type No. 40702, U. S. Nat. Mus., without locality (Schaus Collection).

Family DALCERIDAE

Genus DALCERA Herrich-Schäffer

Dalcera consanguinea, new species

Fore wing pale purple, shading to blackish outwardly; costal margin, inner and outer margins narrowly, pale yellow. Hind wing orange yellow with a narrow outer black border, in width less than one-fourth the length of the wing. Expanse, male, 39–45 mm.

Two males, Type No. 40713, U. S. Nat. Mus., Rio Tapajoz, Amazonas, Brazil; Porto Velho, Rio Madeira, Brazil (Dognin Collection).

Perhaps not distinct from *Dalcera semirufa* Druce, which I know only by description.

Genus ACRAGA Walker

Acraga perbrunnea, new species

Dark purple, uniform, the hind wings apparently of the same color, though badly denuded in the specimen. Expanse, male, 25 mm.

One male, Type No. 40714, U. S. Nat. Mus., Oxapampa, Peru, 2000 m. alt. (Dognin Collection).

Genus ANACRAGA Dyar

Anacraga citrinopsis, new species

Color of *citrina* Schaus, but considerably larger. Expanse, male, 25 mm.

One male, Type No. 40715, U. S. Nat. Mus., Callao, Peru (Mrs. M. J. Pusey).

Anacraga ingenescens, new species

Fore wing dull golden yellow, color of *ria* Dyar (*luteola* Hopp); hind wing pale yellow, more golden on the margin. Expanse, female, 32 mm.

One female, Type No. 40716, U. S. Nat. Mus., Merida, Venezuela (Dognin Collection).

Anacraga sororcula, new species

Like *sofia* Dyar, smaller, most of the wing markings except the discal dot faint and obsolescent. Expanse, male, 12 mm., female, 16–17 mm.

Four males, two females, Type No. 40717, U. S. Nat. Mus., Cayuga, Guatemala, May, September, October (Schaus & Barnes); Misantla, Mexico, September, 1910 (R. Müller).

Anacraga phasma, new species

White faint yellowish clouded markings on lower half of wing; no discal dot. Expanse, female, 17 mm.

One female, Type No. 40718, U. S. Nat. Mus., Venadio, Sinaloa, Mexico (A. Kusche).

Genus PROTACRAGA Hopp

Protacraga nigerella Dognin

Dognin's *Dalcera nigerella* is apparently the male of Hopp's *Protacraga micans.*

Genus MINONOA Dyar

Contains the following species:

Minonoa perbella Schaus (genotype)

Minonoa variegata Jones (*Dalcera variegata* Jones)

I have not examined specimens of this species, but feel sure from the wing shape and pattern of coloration that it will find place in this genus.

Minonoa elvira Dognin (*Acraga elvira* Dognin)

Dognin's types are before me. The disparity in the sexes in color and even pattern of markings is remarkable.

SCIENTIFIC NOTES AND NEWS

The annual series of lectures representative of the work of the Carnegie Institution of Washington was given in November and December, and included the following: November 15, OSCAR RIDDLE, *Internal secretions in evolution and reproduction;* November 22, J. P. AULT, *Purpose and progress of ocean surveys;* November 29, REMINGTON KELLOGG, *History of whales—their adaptation to life in the sea;* November 30, S. G. MORLEY, *Excavations at Chichen Itza, Yucatan, Mexico, and at Uaxactun, Peten, Guatemala, in 1927* (presented at the Bureau of American Republics); December 6, WALTER S. ADAMS, *The interior of a star and how it maintains its life.* The annual reception and exhibit of apparatus and methods was held on December 9.

Obituary

Mr. FRANK SPRINGER, a member of the ACADEMY, died September 22, 1927, at the age of seventy-nine. Mr. Springer was born in Iowa and received his earlier education in that state. As a young man he moved to New Mexico and soon became prominent as a lawyer, a successful business man, and a participant in public affairs. An interest in the study of the fossil crinoids aroused in his younger days in Iowa, however, remained with him to the end of his career and resulted in extensive collections and in descriptive monographs that rank among the major contributions to American paleontology. Mr. Springer's magnificent collection and his library of crinoid literature have been housed for a number of years in the U. S. National Museum and were given by him to the Museum.

Professor MILTON WHITNEY, a member of the ACADEMY and for more than thirty years Chief of the Bureau of Soils, Department of Agriculture, died November 11, 1927, in his 67th year. He was born in Baltimore, Maryland, and was educated in the schools of that city and at Johns Hopkins University. Before taking charge of the Bureau of Soils he was attached to Agricultural Experiment Stations in Connecticut, North Carolina, South Carolina, and Maryland, and was Professor of Agriculture at the University of South Carolina. His numerous publications deal with soil physics and other problems connected with soils.

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